# PATENT SPECIFICATION

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COMPLETE SPECIFICATION

## Improvements in Steering Gears for Mechanically Propelled Vehicles

We, REGINALD BISHOP, of 145 The Vale, Golders Green, London, N.W.11, and ROBERT HENRY JOHNSTON, of Flowton Priory, Harpenden, Hertfordshire, both Subjects of the Queen of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a steering gear for mechanically propelled vehicles and is concerned with a steering gear of the kind including a rack-bar displaceable endwise within a guide tube disposed transversely of the length of the vehicle chassis, due to the rotation of a pinion which is secured on the steering shaft and meshes with the teeth of the rack-bar.

In such a steering gear the internal surface of the guide tube has been formed with longitudinally extending channels or grooves equiangularly spaced around the axis of the tube and arranged so that two of the grooves or channels are disposed opposite the respective lateral edges of the toothed portion of the rack-bar. These grooves or channels not only provide for the passage of lubricant between the rack-bar and the guide tube but also afford a limited amount of transverse play to the rack-bar in the neighbourhood of the pinion so that the bar may be urged in the direction of the latter in order to maintain the teeth of the rack-bar in close engagement with those of the pinion. As previously proposed, a spring-pressed slipper member has been located at the side of the rack-bar remote from the pinion and arranged to exert a relatively considerable pressure upon the bar. The disadvantage of such an arrangement is that the friction between the slipper member and the rack-bar is so high that the steering gear becomes unduly stiff.

It is the object of the present invention to provide an improved steering gear of the kind referred to in which this disadvantage shall be obviated.

According to the invention a steering gear of the kind referred to comprises a freely rotatable roller which is urged by spring means into contact with the rack-bar on the side thereof remote from the pinion.

It is preferred, nevertheless, to provide a spring-pressed slipper member of substantially the same character as that previously proposed but to locate this at or near the end of the rack bar remote from the pinion. Since, owing to its location, the slipper member has merely to maintain the bar in close engagement with the bearing surface provided therefor, the pressure to be exerted by the slipper member upon the bar is relatively light and no undue friction is engendered.

Because the spring-pressed roller according to this invention is freely rotatable, the relatively high pressure required to maintain the rack teeth in engagement with the teeth of the pinion, despite road shocks or the like, may be satisfactorily applied without the sliding motion of the rack-bar being impeded in any way. The periphery of the roller is preferably grooved circumferentially so that it can fit against the rack-bar across substantially the whole of its width. One example of the way in which the invention may be carried into effect will now be described in greater detail reference being made to the accompanying drawings in which:—

Fig. 1 is a section taken on the longitudinal axis of the rack-bar;

Fig. 2 is a section taken on the line II—II of Fig. 1, and

Fig. 3 is a section taken on the line III—III of Fig. 1.

A cylindrical rack-bar 1, having straight transverse teeth 2 cut thereon over a portion of its length near one end, is slidably arranged within a cylindrical guide tube 3 which is provided at one end with a bearing sleeve 4 in which the cylindrical portion of the bar 1 is a close sliding fit. This sleeve 4 is formed with a radial screw-threaded aperture 5 in which is engaged a hollow screwed plug

6 containing a cup-like slipper member 7 normally urged towards the axis of the bar 1 by means of a spring 8 contained partly within the slipper member 7 and partly within the hollow of the plug 6. Under the action of its spring 8, this slipper member 7 constantly urges the rack-bar 1 against the opposed surface of the bearing sleeve 4. A pinion 9 is rotatably mounted in a housing 10 secured on the end of the guide tube 3 remote from the bearing sleeve 4 to mesh with the rack teeth 2.

The internal diameter of the guide tube 3 is slightly larger than the diameter of the untoothed portion of the rack-bar 1 and the tube 3 is formed with three longitudinally extending channels 11 in its inner surface disposed at 120° from each other around the axis of the tube 3 and arranged so that two of them are located opposite the respective ends of the teeth 2 on the bar 1. As will be appreciated, this relieving of the tube 3 permits the toothed portion 2 of the bar 1 to move slightly, transversely of its axis, in the direction of the pinion 9 in the housing 10. The latter surrounds the rack with adequate clearance and is formed with a radially extending tubular projection 11 at the side opposite to the pinion 9. Within this tubular projection 11 is slidably mounted a cup-shaped element 12 formed on its inwardly directed face with a pair of spaced lugs 13 each formed with an open-ended slot 14 adapted to receive rotatably one end of a short spindle 15 on which is mounted a roller 16 having a grooved periphery adapted to run on the adjacent surface of the rack-bar 1.

The length of the spindle 15 is greater than the internal diameter of the tubular projection 11 and is such that each end thereof will extent for a short distance beyond the outer surface of the respective lug 13 when received within the associated slot 14, the element 12 and the lugs 13 being a relatively close fit within the tubular projection 11. The internal wall of this projection 11 is formed with a pair of grooves 17 of a depth just sufficient to accommodate the projecting ends of the spindle 15. These grooves 17 are formed parallel to the axis of the tubular projection 11 and extend for substantially the whole length thereof and are located one at each end of that diameter of the projection 11 which is normal to the direction of travel of the rack-bar 1.

The diameter of the passage through the projection 11 is enlarged towards the outer end thereof by an amount greater than the depth of both grooves 17 to form a shoulder 18, into which the outer ends of the grooves 17 open, and which is threaded to receive a closure 19 which, when in position, effectively seals off the outer ends of the grooves 17.

A relatively strong helical compression spring 20 is disposed between the cup 12 and the closure 19 and constantly urges the roller 16 into engagement with the rack-bar 1, with a force sufficient to maintain the rack teeth 2 in engagement with the teeth on the pinion 9. Shims (not shown) may be interposed between the closure 19 and the shoulder 18 so that the pressure exerted by the spring 20 can be adjusted as desired.

It will be appreciated that although the requisite relatively heavy pressure is exerted upon the rack-bar, the latter is not impeded in its axial sliding motions because the pressure-applying roller is free to rotate. Since the slipper at the other end of the rack-bar has now only to exert a relatively light pressure upon the latter, the frictional resistance produced at that end of the bar is relatively small and within permissible limits. The arrangement described has the further advantage that the rack-bar can yield resiliently under the action of road shocks against the action of the springs provided.

It will be understood that the grooves 17 in the tubular projection 11 accurately locate the ends of the spindle 15 and prevent the roller 16 being located in any position other than the correct one, *i.e.* that in which the axis of rotation is normal to the direction of travel of the rack-bar 1.

What we claim is:—

1. A steering gear of the kind referred to comprising a freely rotatable roller which is urged by spring means into contact with the rack-bar on the side thereof remote from the pinion.

2. A steering gear according to claim 1 wherein the pinion engages with the rack-bar towards one end of the latter and a spring-pressed slipper member engages with the rack-bar towards the other end of the latter.

3. A steering gear according to claim 1 or 2 wherein the periphery of the roller is grooved circumferentially so that it can fit against the rack-bar across substantially the whole of its width.

4. A steering gear of the kind referred to constructed, arranged and adapted to operate substantially as herein described and as illustrated in the accompanying drawings.

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PROVISIONAL SPECIFICATION

## Improvements in Steering Gears for Mechanically Propelled Vehicles

We, REGINALD BISHOP, of 145 The Vale, Golders Green, London, N.W.11, and ROBERT HENRY JOHNSTON, of Flowton Priory, Harpenden, Hertfordshire, both Subjects of

the King of Great Britain, do hereby declare this invention to be described in the following statement:—

This invention relates to steering gears for mechanically propelled vehicles and is concerned with steering gears of the kind including a rack-bar displaceable endwise within a guide tube disposed transversely of the length of the vehicle chassis, due to the rotation of a pinion which is secured on the steering shaft and meshes with the teeth of the rack-bar.

In such steering gears the internal surface of the guide tube has been formed with longitudinally extending channels or grooves equiangularly spaced around the axis of the tube and arranged so that two of the grooves or channels are disposed opposite the respective lateral edges of the toothed portion of the rack-bar. These grooves or channels not only provide for the passage of lubricant between the rack-bar and the guide tube but also afford a limited amount of transverse play to the rack-bar in the neighbourhood of the pinion so that the bar may be urged in the direction of the latter in order to maintain the teeth of the rack-bar in close engagement with those of the pinion. As previously proposed, a spring-pressed slipper member has been located at the side of the rack-bar remote from the pinion and arranged to exert a relatively considerable pressure upon the bar. The disadvantage of such an arrangement is that the friction between the slipper member and the rack-bar is so high that the steering gear becomes unduly stiff.

It is the object of the present invention to provide an improved steering gear of the kind referred to in which this disadvantage shall be obviated.

According to the invention the spring-pressed slipper member is replaced by a freely rotatable roller which is urged towards the rack-bar by spring means.

It is preferred, nevertheless, to provide a spring-pressed slipper member of substantially the same character as that previously proposed but to locate this at or near the end of the rack-bar remote from the pinion. Since, owing to its location, the slipper member has merely to maintain the bar in close engagement with the bearing surface provided therefor, the pressure to be exerted by the slipper member upon the bar is relatively light and no undue friction is engendered.

Because the spring-pressed roller according to this invention is freely rotatable, the relatively high pressure required to maintain the rack teeth in engagement with the teeth of the pinion, despite road shocks or the like, may be satisfactorily applied without the sliding motion of the rack-bar being impeded in any way. The periphery of the roller is preferably grooved circumferentially so that it may fit against the rack-bar across substantially the whole of its width.

One example of the way in which the invention may be carried into effect will now be described in greater detail.

A cylindrical rack-bar, having straight transverse teeth cut thereon over a portion of its length near one end, is slidably arranged within a cylindrical tube which is provided at one end with a bearing sleeve in which the cylindrical portion of the bar is a close sliding fit. This sleeve is formed with a radial screw-threaded aperture in which is engaged a hollow screwed plug containing a cup-like slipper member normally urged towards the axis of the bar by means of a spring contained partly within the slipper member and partly within the hollow of the plug. Under the action of its spring, this slipper member constantly urges the rack-bar against the opposed surface of the bearing sleeve. A pinion is rotatably mounted in a housing secured on the end of the guide tube remote from the bearing sleeve to mesh with the rack teeth.

The internal diameter of the guide tube is slightly larger than the diameter of the untoothed portion of the rack-bar and the tube is formed with three longitudinally extending channels in its inner surface disposed at 120° from each other around the axis of the tube and arranged so that two of them are located opposite the respective ends of the teeth on the bar. As will be appreciated, this relieving of the tube permits the toothed portion of the bar to move slightly, transversely of its axis, in the direction of the pinion in the housing. The latter surrounds the rack with adequate clearance and is formed with a radially extending tubular projection at the side opposite to the pinion. Within this tubular projection is slidably mounted a cup-shaped element formed on its upper face with a pair of spaced lugs each formed with an open-ended slot adapted to receive rotatably one end of a short spindle on which is mounted a roller having a grooved periphery adapted to run on the adjacent surface of the rack-bar. Between the cup and a closure secured on the end of the tubular projection there is disposed a relatively strong helical compression spring which constantly urges the roller into engagement with the rack-bar with a force sufficient to maintain the rack teeth in engagement with the teeth on the pinion. The end closure is secured to a flange provided around the tubular projection with the interposition of shims so that the pressure exerted by the spring may be adjusted as desired.

It will be appreciated that although the requisite relatively heavy pressure is exerted upon the rack-bar, the latter is not impeded in its axial sliding motions because the pressure-applying roller is free to rotate. Since the slipper at the other end of the rack-bar has now only to exert a relatively light pressure upon the latter, the frictional resistance produced at that end of the bar is relatively

small and within permissible limits. The arrangement described has the further advantage that the rack-bar may yield resiliently under the action of road shocks against the action of the springs provided.

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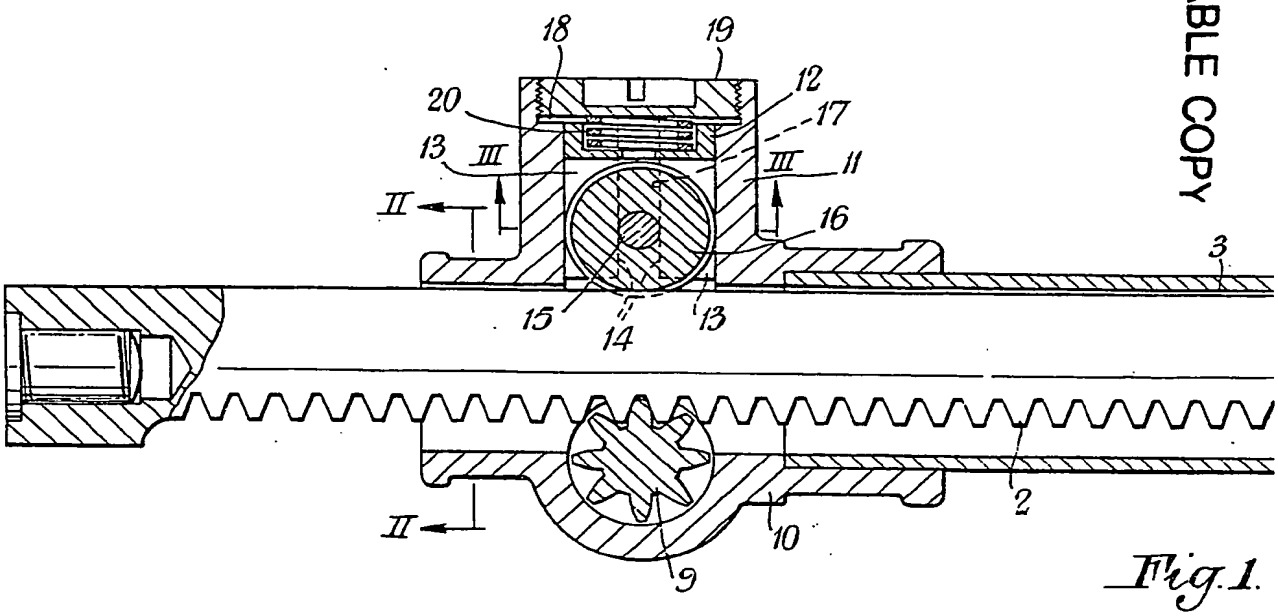


Fig. 1.

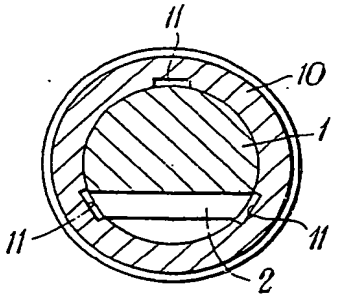


Fig. 2.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

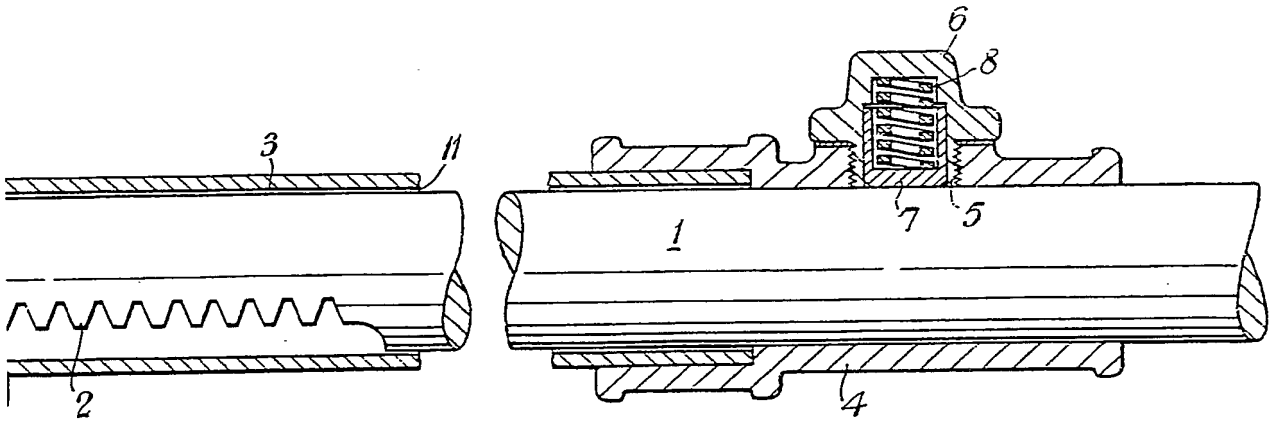


Fig. 1.

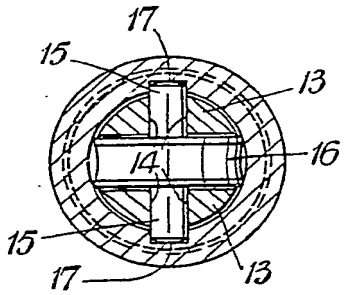


Fig. 3.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

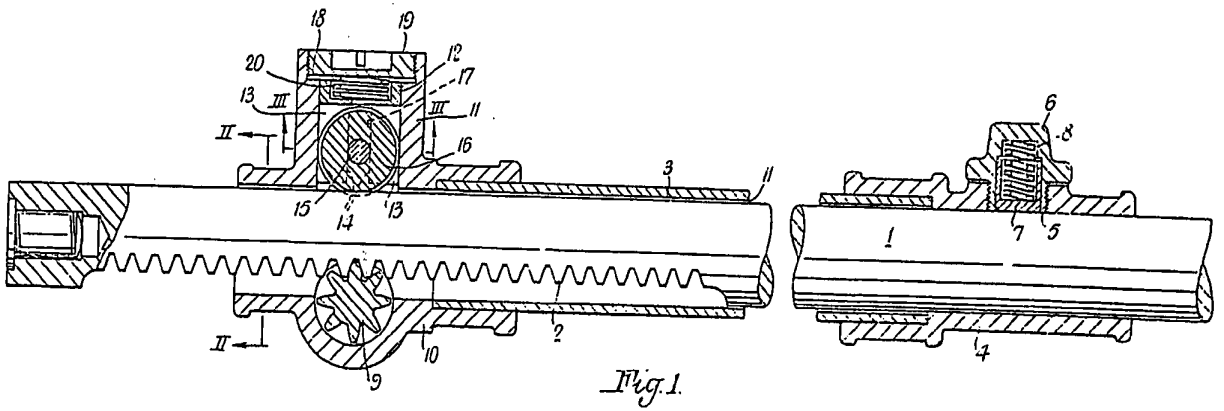
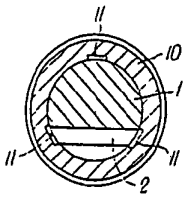



Fig. 1.

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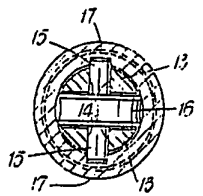


Fig. 3.